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U.S. PATENT APPLICATION

for

BEAM STRUCTURES FOR SHELVING APPARATUS

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present invention claims priority under 35 U.S.C. § 119 from U.S. Provisional Patent Application No. 60/261,329 titled "BEAM STRUCTURES FOR SHELVING ASSEMBLIES" filed January 12, 2001, the full disclosure of which is hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to beam structures for shelving systems or the like. More particularly, the present invention relates to beam structures that provide improved strength and rigidity.

BACKGROUND OF THE INVENTION

[0003] It is generally known to provide for a shelving system made of plastic, metal, wood, or combinations thereof. Such shelving systems typically include a plurality of panels connected and supported by a plurality of posts. Also, such shelving systems are intended to support the weight of one or more objects placed on the panel. It is also known to provide plastic panels with uniform wall thicknesses.

[0004] However, such panels have several disadvantages including a flexural modulus that allows the panel to bow, bend, or flex when weight is maintained over a period of time. Also, the amount of material and the types of material necessary to support anticipated loads may be costly (e.g., high flex modulus materials).

[0005] To provide an inexpensive, reliable, and widely adaptable beam structures that avoids the above-referenced and other problems would represent a significant advance in the art.

SUMMARY OF THE INVENTION

[0006] A primary feature of the present invention is to provide an inexpensive, easy-to-manufacture and aesthetically-pleasing shelving system that overcomes the above-noted disadvantages.

[0007] Another feature of the present invention is to provide a shelving system with an improved beam structure or a combination of beam structures.

[0008] Another feature of the present invention is to provide a shelving system with a beam structure having an increased strength-to-weight ratio and reduces load deflection at minimal part weight increases.

[0009] How these and other advantages and features of the present invention are accomplished (individually, collectively, or in various subcombinations) will be described in the following detailed description of the preferred and other exemplary embodiments, taken in conjunction with the FIGURES. Generally, however, they are accomplished in a support structure for a shelving system that includes a pair of opposing beam members having an upper end, a lower end, and an intermediate wall coupling the upper and lower ends. Upper and lower ends of opposing beam members define a plurality of orifices. A terminal end of the upper end includes a downward projection configured to provide strength and rigidity.

[0010] These and other features of the invention may also be accomplished in a support structure including a set of first beam structures, each having a pair of side walls, an upper wall, and a lower wall defining alternating oppositely disposed cavities, and a set of second beam structures, each having opposing beam members having an upper end, a lower end, and an intermediate wall coupling upper and lower ends. The first and second beam structures are combined to provide particular strength and rigidity characteristics.

[0011] The present invention further relates to various features and combinations of features shown and described in the disclosed embodiments. Other ways in which the objects and features of the disclosed embodiments are accomplished will be described in the following specification or will become apparent to those skilled in the art after they have read this specification. Such other ways are deemed to fall within the scope of the disclosed embodiments if they fall within the scope of the claims which follow.

BRIEF DESCRIPTION OF THE FIGURES

[0012] FIGURE 1 is a perspective view of a shelving unit according to a preferred embodiment.

[0013] FIGURE 2 is a top perspective view of a panel for the shelving unit of FIGURE 1.

[0014] FIGURE 3 is a bottom perspective view of the panel of FIGURE 2.

[0015] FIGURE 4 is a top plan view of the panel of FIGURE 2.

[0016] FIGURE 5 is a bottom plan view of the panel of FIGURE 2.

[0017] FIGURE 6 is a fragmentary sectional view of the panel of FIGURE 5 taken along the line 6--6.

[0018] FIGURE 7 is a side elevation view of the panel of FIGURE 2.

[0019] FIGURE 8 is a sectional view of the panel of FIGURE 4 taken along the line 8--8.

[0020] FIGURE 9 is a sectional view of the panel of FIGURE 4 taken along the line 9--9.

[0021] FIGURE 10 is a side elevation view of the panel of FIGURE 2.

[0022] FIGURE 11 is a sectional view of the panel of FIGURE 4 taken along the line 11--11.

[0023] FIGURE 12 is a fragmentary sectional view of the panel of FIGURE 11.

[0024] FIGURE 13 is a fragmentary top plan of a socket for the panel of FIGURE 2.

[0025] FIGURE 14 is a fragmentary bottom plan view schematic block flow diagram of the socket of FIGURE 13.

[0026] FIGURE 15 is a fragmentary sectional view of the socket of FIGURE 14 taken along the line 15--15.

[0027] FIGURE 16 is a fragmentary sectional view of the socket of FIGURE 14 taken along line 16--16.

[0028] FIGURE 17 is a fragmentary sectional view of the socket of FIGURE 14 taken long the line 17--17.

[0029] FIGURE 18 is a fragmentary sectional view of the socket of FIGURE 17.

[0030] FIGURE 19 is a top perspective view of a panel for a shelving unit according to an exemplary embodiment.

[0031] FIGURE 20 is a bottom perspective view of the panel of FIGURE 19.

[0032] FIGURE 21 is a fragmentary top plan view of the panel of FIGURE 19.

[0033] FIGURE 22 is a side elevation view of the panel of FIGURE 21.

[0034] FIGURE 23 is a fragmentary bottom plan view of the panel of FIGURE 21.

[0035] FIGURE 24 is a front elevation view of the panel of FIGURE 21.

[0036] FIGURE 25 is a sectional view of the panel of FIGURE 21 taken along the line 25—25.

DETAILED DESCRIPTION OF PREFERRED AND OTHER EXEMPLARY EMBODIMENTS

[0037] Before proceeding to the detailed description of the preferred and exemplary embodiments, several comments can be made about the general applicability and the scope thereof.

[0038] First, while the components of the disclosed embodiments will be illustrated as a shelving apparatus designed for a variety of items over short and/or long periods of time, the features of the disclosed embodiments have a much wider applicability. For example, the beam structure design is adaptable for other storage units, bins, containers, and other office, home, or educational products which employ a storage space configured to support items relative to one or more force concentration areas. Further, the size of the various components and the modularity of the shelving system is only preferred and can be widely varied.

[0039] Second, the particular materials used to construct the exemplary embodiments are also illustrative. For example, injection molded mineral-reinforced polypropylene is the preferred method and material for making the top and base, but other materials can be used, including other thermoplastic resins such as polypropylene, high density polyethylene, other polyethylenes, acrylonitrile butadiene styrene ("ABS"), polyurethane, nylon, any of a variety of homopolymer plastics, copolymer plastics, structural foam plastics with special additives, filled plastics, etc. Also, other molding operations may be used to form these components, such as blow molding, rotational molding, gas-assist injection molding, etc. The mold tooling preferably includes a projection (e.g., steel) on both the cavity and core to provide the desired design in either beam configuration.

[0040] Proceeding now to descriptions of the preferred and exemplary embodiments, FIGURE 1 shows a shelving system 10 according to a preferred embodiment. Shelving system 10 includes one or more panels (panel 12a in FIGURES

2-18 and panel 12b in FIGURES 19-25) supported by a plurality of posts 14. Each post 14 includes a shaft 16, a top portion 18, and a bottom portion 20. Top portion 18 and/or bottom portion 20 of posts 14 are configured to couple with sockets 22a of panel 12a or 12b. Posts 14 and sockets 22a are further disclosed in U.S. Patent No. 6,079,339 which is incorporated herein by reference.

[0041] Panel 12a or 12b includes a support surface 24, a skirt 26 that extends generally downward around the perimeter of support surface 24, plurality of sockets 22a disposed generally at the corners of panel 12a or 12b, and a plurality of support structures (shown as rails or beams 28 in FIGURES 2-18, and rails or beams 30 in FIGURES 19-25). According to a preferred embodiment, the beams are spaced evenly across the width of panel 12a and span substantially the entire length of the panel. According to alternative embodiments, beams 28 or 30 may be concentrated in regions of increased stress loads and include one or more beams. Beams 28 terminate at a wall 32 that connects a pair of sockets 22a. Beams 30 terminate at skirt 26 or sockets 22.

[0042] Panels 12a also include a plurality of ribs 34 connect beams 28 or 30 with a lower side 36 of support surface 24. According to a preferred embodiment, ribs 34 are generally perpendicular and/or parallel to beams 28 or 30 and have varying dimensional characteristics. Also, ribs 34 may have any of a variety of dimensional characteristics (e.g., width, thicknesses, heights, etc.).

[0043] Referring to FIGURES 2-18, each beam 28 includes a pair of opposing beam members (shown as "Z"-shaped members 38, wherein "Z-shaped"

refers to the cross-sectional appearance of adjacent halves of the beam). Each Z-shaped member 38 includes an intermediate wall 40 and a pair of ends (shown as an upper end 42 and a lower end 44). Upper end 42 and lower end 44 provide structure for adjacent beams 28. An upper side 46 of upper end 42, at least partially, comprise support surface 24. According to a preferred embodiment, intermediate wall 40 is generally vertical and approximately perpendicular to support surface 24. According to alternative embodiments, intermediate wall 40 generally not perpendicular to support surface 24 and may be configured to have any of a variety of angles relative to support surface 24.

[0044] A plurality of apertures 48 are defined by opposed lower ends 44 and a lower rib 50. A plurality of apertures 52 in support surface 24 are defined by opposed upper ends 42 and an upper rib 54. A "small return" (shown as a projection 56) extends generally downward about apertures 52. Projection 56 is intended to provide additional rigidity to support surface 24 and provide a smoother support surface 24 without additional finishing operations after panel 12a is molded. According to alternative embodiments, projection 56 has any of a variety of heights which may be configured to support the intended or anticipated load.

[0045] As shown in the cross sectional view in FIGURE 9, adjacent "Z"-shaped members 38 alternate directions across the width of panel 12a and form a continuous support along the length of panel 12a. The particular dimensional characteristics of "Z"-shaped members 38, are intended to provide increased strength and flexural resistance.

[0046] According to an exemplary embodiment, upper ends 42 and lower ends 44 have an increased amount of material than in known "Z"-shaped supports. Such a configuration provides increased manufacturing efficiencies and strength-to-weight ratios. According to a preferred embodiment, upper ends 42 and lower ends 44 have a greater amount of wall thickness than intermediate wall 40, and extend further from intermediate wall 40 than in known "Z"-shaped supports. According to a particularly preferred embodiment, upper ends 42 and lower ends 44 have about 50% larger wall thickness than intermediate wall 40, and extend out from intermediate wall 40 by approximately 100% (i.e., approximately twice as far). According to alternative embodiments, the additional distance which upper ends 42 and lower ends 44 wall thickness of ends and project from intermediate wall 40 may be determined by the desired performance characteristics (e.g., between about 20% and about 200%). By increasing strength and flexural resistance, panel 12a requires a reduced number of beams per square inch or square feet of surface area. Reducing the number of beams is intended to reduce the overall panel weight thereby reducing manufacturing and shipping costs. Also, adopting one or more of these design embodiments, the height of the intermediate wall need not be increased for additional strength.

[0047] As shown in FIGURE 8, ends 42, 44 of some "Z"-shaped members 38 provide a first height H1 which is less than the height of intermediate portion 40. According to a preferred embodiment, "Z"-shaped members 38 have a curvilinear parabolic shape with a vertex approximately in the middle of "Z"-shaped members 38. According to a particularly preferred embodiment, "Z"-shaped members

38 nearest skirt 26 have a continuous height, and inner "Z"-shaped members 38 have the curved configuration (e.g., to save on material and ship weight).

[0048] As shown in FIGURES 3, 13, and 14, intermediate walls 40 and wall 32 are configured to terminate at socket 22a for a stronger integration and connection with sockets 22a. As shown, outer wall 58 of socket 22a is generally planer (e.g., flattened out) so that wall 32 may continue towards skirt 26. Generally planar outer wall 58 at sockets 22a are intended to provide additional strength, strength characteristics that are more predictable, require simpler tooling for molds.

[0049] According to an exemplary embodiment, panel 12a is approximately 38 inches by 24 inches. (Alternatively, the panel is approximately 42 inches by 24 inches, or have any of a variety of dimensions according to desired storage needs.) According to an exemplary embodiment, upper end 42 is between about 0.500 inches and about 1.000 inches. According to a preferred embodiment, upper end 42 is approximately 0.750 inches. According to a particularly preferred embodiment, upper end 42 is approximately 0.719 inches. According to alternative embodiments, the upper end may be any of a variety of dimensions depending on the configuration and size of the shelf system.

[0050] According to an exemplary embodiment, lower end 44 is between 0.500 inches and 1.000 inches. According to a preferred embodiment, lower end 44 is approximately 0.750 inches. According to a particularly preferred embodiment, lower end 44 is approximately 0.751 inches. According to alternative embodiments, the lower

end may be any of a variety of dimensions depending on the configuration and size of the shelf system.

[0051] Referring to FIGURES 19-25, panel 12b is shown with sockets 22b and "box" beams 30 according to an alternative embodiment. "Box" beams 30 include a set of alternating opposed cavities 60, 62 defined by side walls 64, 66, an upper wall 68, and a lower wall 70. Upper wall 68 includes an aperture 72. Lower wall 70 includes an aperture 74. According to a preferred embodiment, aperture 74 is larger than aperture 72 to maximize support surface 74 and minimize weight and material without reducing flexural strength.

[0052] As shown, three beams 30 are disposed across the width of panel 12b. According to alternative embodiments, any number of beams may be employed in panel 12b according to desired strength characteristics. Also as shown, beams 30 have a constant height across the length of panel 12b. According to alternative embodiments, height may vary (e.g., have a reduced height near skirt 26) and an increased height near the middle of panel 12b (e.g., to affect deflection characteristics or to minimize material).

[0053] According to a preferred embodiment, a pair of "Z"-shaped beams 76 are disposed between "box" beams 30. "Z"-shaped beams 76 is shown to span ends of panel 12b. According to a preferred embodiment, ends 78 of "Z"-shaped beams 76 have a first height HH1 which is less than a second height HH2 an intermediate portion 80. "Z"-shaped beams 76 have a curvilinear parabolic shape with a vertex approximately in the middle of "Z"-shaped beams 76.

[0054] "Z"-shaped beams 76 include a pair of intermediate side walls 82, 84, a bottom wall 86, and a rib 88 perpendicular to side walls 82, 84. A plurality of cavities 90 are defined by side walls 82, 84, bottom walls 86, and rib 88. According to a preferred embodiment, plurality of ribs 34 are disposed between beams 30 and "Z"-shaped beams 76, and are perpendicular to side walls 64, 66 of beams 30 and side walls 82, 84 of "Z"-shaped beams 76. Alternatively, ribs 34 extend from lower side 36 of support surface 24 so as to increase rigidity. Ribs 34 are disposed generally parallel with both beams 30 and "Z"-shaped beams 76 and have any of a variety of heights.

[0055] It is also important to note that the construction and arrangement of the elements of the beam structures as shown in the preferred and other exemplary embodiments are illustrative only. Although only a few embodiments of the present invention have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. For example, such beam structures may be applied to pallets, stepstools, or any plastic surface that requires high strength at optimized part weights. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined in the appended claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. In the claims, any means-plus-function clause is intended to

cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and/or omissions may be made in the design, operating conditions and arrangement of the preferred and other exemplary embodiments without departing from the spirit of the present invention as expressed in the appended claims.